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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/583,386 05/30/00 CARLEY

L 000265

023464

MMC2/0607

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EXAMINER

KIELIN, F

ART UNIT

PAPER NUMBER

2813

DATE MAILED:

06/07/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trad marks

Office Action Summary

Application No.

09/583,386

Applicant(s)

CARLEY, L. RICHARD

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 October 2000.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 May 2000 is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- 15) ☒ Notice of References Cited (PTO-892)
- 16) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 18) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 19) ☐ Notice of Informal Patent Application (PTO-152)
- 20) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: 7 and 9, on page 4, line 30. Correction is required.

Specification

1. The disclosure is objected to because of the following informalities:
on pp. 3-4, and throughout the specification, lower case letters have been used with numbers to refer to the figures in the specification, but upper case letters are used in the actual figures, these letters must match for clarity; and
on page 4, line 9, replace “7, 7a and 7b” with --7A, 7B, and 7C-- to match the figures.
Appropriate correction is required.

Claim Objections

2. A series of singular dependent claims is permissible in which a dependent claim refers to a preceding claim which, in turn, refers to another preceding claim.

A claim which depends from a dependent claim should not be separated by any claim which does not also depend from said dependent claim. It should be kept in mind that a dependent claim may refer to any preceding independent claim. In general, applicant's sequence will not be changed. See MPEP § 608.01(n).

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3. Claim 13 objected to because of the following informalities:

in claim 13, line 2, replace “or” with –of– for clarity;

in claim 15, line 1, remove “all” for clarity; and

in claim 15, line 1, replace “are” with – is – for correct grammar.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claims 17-20 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 15, from which claim 17 depends, requires that each of the sacrificial layers be the same material, yet claim 17 requires that the sacrificial layers “may be composed of different materials.” This is not possible. This problem propagates through claims 18-20.

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 1-20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

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8. Claim 1 recites the limitation “the last sacrificial layer” in line 12. There is insufficient antecedent basis for this limitation in the claim.

The term “last” is also a relative term, and it is unclear as to which layer is “the last of the sacrificial layers.” Is it the last deposited? Is it the last removed? Is it the last of a particular material type?

The claim is made further unclear because “said etchant” is necessarily the same etchant used to etch all sacrificial layers, not just “the last sacrificial layer.” For this reason there is a suggestion that more than one etchant may be used, but this is not claimed, as presently written.

Claims 2-20 are indefinite for depending from independent claim 1.

For the purposes of determining patentability of the subject matter, the claims will be examined as best understood by Examiner.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 1-2, 5-14, 17-20 rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant’s admitted prior art (APA) in view of Core et al. (US 5,314,572).

Applicant’s APA clearly discloses that it is known to fabricate a microstructure in a sealed cavity comprising providing a substrate, one or more sacrificial layers, structural layers, first seal (encapsulating) layer with holes to provide flow of liquid etchant for removing

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sacrificial material, and sealing off the holes by depositing another seal layer over the holes. (See specification, pp. 1-2).

Applicant's APA does not teach using a "non-liquid etchant."

Core teaches a method of forming a MEMS comprising providing a silicon substrate, sacrificial layers of low temperature oxide (LTO) 30 and photoresist 38a (Fig. 7), structural layers of polysilicon 20, and using first a wet etch to remove the LTO 30 and lastly removing the sacrificial photoresist 38a using a dry oxygen plasma etch specifically to circumvent problems associated with surface tension created by wet etching. (See **Core**, col. 1, ll. 61-66; col. 3, ll. 31-46; col. 5, l. 50 to col. 1. 63 -- especially col. 6, ll. 6-15, 40-43.) Note that Applicant indicates the objective of the instant invention is to overcome the problems of surface tension by using a "non-liquid etchant" for at least the removal of the last sacrificial layer (specification, p. 3, ll. 10-24).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a non-liquid etchant for the reasons indicated in **Core**, which are incidentally the same as Applicant's.

Regarding claims 17-20, while claims 17-20 depend directly or indirectly from claim 15, there is a clear enablement problem as indicated above. Because the sacrificial materials cannot be simultaneously the same material (claims 15) and different materials (claims 17-20), Examiner assumes for the purpose of this rejection that the pendency of the claims 17-20 is incorrect. **Core** provides the key subject matter which teaches the benefits the use of plural, different sacrificial layers combined with a first wet etching and a last dry etching for the same purpose as Applicant uses this etching combination.

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11. Claims 1-2, 4-12, 15, 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art (**APA**) in view of **Hornbeck** (US 5,083,857).

Applicant's **APA** is applied as above.

Applicant's **APA** does not teach using a "non-liquid etchant."

Hornbeck teaches a method of fabricating a MEMS on a prefabricated CMOS silicon substrate 503 wherein each of the sacrificial layers 701, 705 is formed of photoresist and the structural layers 703, 704, 200 are formed of aluminum and the photoresist is removed using dry oxygen plasma etch. (See Figs. 7a-7d; col. 3, l. 54 to col. 4, l. 52.)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a non-liquid etchant for the reasons indicated in **Hornbeck**, and at least because the method in **Hornbeck** is indicated to be compatible with CMOS substrates and processing.

Regarding claim 4, although **Hornbeck** does not indicate that the plasma is oxygen plasma, Examiner gives official notice that it is notoriously well known to use oxygen plasma to remove photoresist. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use oxygen plasma as the plasma in **Hornbeck** because it is standard practice in the art to remove photoresist using oxygen plasma.

12. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over either of Applicant's **APA**) in view of **Core** as applied to claims 1-2, 5-14, 17-20 above, or Applicant's **APA** in view of **Hornbeck** as applied to claims 1-2, 4-12, 15, 16 above, either in further in view of **Muller et al.** (US 5,493,177).

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The prior art as explained above discloses all of the limitations of claims except for using silicon nitride on the silicon substrate.

Muller teaches a method of fabricating a MEMS wherein silicon nitride 178 on a silicon wafer is used. (See col. 9, ll. 23-30.)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the **Muller** silicon nitride layer of the substrate because Applicant admits (specification, p. 2) that Muller is known prior art and that Muller uses a protective layer on the silicon substrate and Muller indicates that this layer is silicon nitride, as noted above.

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

Montague et al. (US 5,798,283) discloses a sealed-cavity MEMS fabrication method using plural sacrificial layers, plural structural layers, seal layers, holes for etchant, and liquid etchant (See Figs).

Offenberg (US 5,683,591) discloses a MEMS fabrication method using two different etchants wherein wet etching is used to remove silicate and oxygen plasma etch is used to remove photoresist (col. 3, l. 40 to col. 4, l. 3).

Cole et al. (US 6,238,580 B1) discloses a MEMS fabrication method using wet and vapor phase etching to remove sacrificial layers (cover figure).

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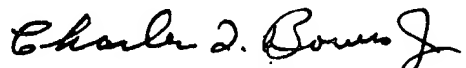
The article to **Storment**, et al. entitled, "Flexible dry-released process for aluminum electrostatic actuators," Journal of Microelectromechanical Systems, 3(3), 9/1994, IEEE, pp. 90-96 discloses the instant invention except for the second sealing layer.

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Charles Bowers, can be reached at (703) 308-2417 or by e-mail at charles.bowers@uspto.gov. The fax phone number for the group is (703) 308-7722 or -7724.


EK

06/04/01


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